

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIFTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019**

**Course Code: CS361**

**Course Name: SOFT COMPUTING**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 3 marks.*

Marks

- |   |   |     |
|---|---|-----|
| 1 | Compare and contrast biological neuron and artificial neuron (3 points)   | (3) |
| 2 | Obtain the output of the neuron for a network with inputs are given as $[x_1, x_2] = [0.7, 0.8]$ and the weights are $[w_1, w_2] = [0.2, 0.3]$ with bias = 0.9.<br>Use i) Binary sigmoidal activation function<br>ii) Bipolar sigmoid activation function | (3) |
| 3 | State the training algorithm for multiple output classes in Perceptron.   | (3) |
| 4 | What is the role of Widrow-Hoff rule in Adaptive Linear neuron? Give appropriate equations.   | (3) |

**PART B**

*Answer any two full questions, each carries 9 marks.*

- |   |   |     |
|---|---|-----|
| 5 | a) List any four activation functions with their equations and graphs.  | (4) |
|   | b) Implement $NOR(x_1, x_2)$ where $x_1, x_2 \in [0,1]$ using MP neuron.  | (5) |
| 6 | a) Draw the flowchart of Hebb training algorithm.   | (4) |
|   | b) Design a Hebb net to implement NOR function using with bipolar inputs and targets.   | (5) |
| 7 | a) Find the weights required to perform the following classifications using perceptron network:<br>The vectors (1, 1, -1, -1) and (1, -1, 1, -1) are belonging to a class having target value 1. The vectors (-1, -1, -1, 1) and (-1, -1, 1, 1) are belonging to a class having target value -1. Assume learning rate 1 and initial weights as 0. | (5) |
|   | b) Draw the architecture of Back-Propagation network. Write its testing algorithm.  | (4) |

**PART C**

*Answer all questions, each carries 3 marks.*

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|---|---|-----|
| 8 | Why the Law of Excluded Middle does not get satisfied in fuzzy sets?  | (3) |
| 9 | Consider a local area network (LAN) of interconnected workstations that communicate using Ethernet protocols at a maximum rate of 20 Mbit/s. The two fuzzy sets given below represent the loading of the LAN: | (3) |

$$\mu_{\tilde{S}}(x) = \left\{ \frac{1.0}{0} + \frac{1.0}{1} + \frac{0.9}{2} + \frac{0.4}{5} + \frac{0.1}{7} + \frac{0.3}{9} + \frac{0.0}{10} \right\}$$

$$\mu_{\tilde{C}}(x) = \left\{ \frac{0.0}{0} + \frac{0.1}{1} + \frac{0.3}{2} + \frac{0.5}{5} + \frac{0.3}{7} + \frac{0.8}{9} + \frac{1.0}{10} \right\}$$

where  $\tilde{S}$  represents silent and  $\tilde{C}$  represents congestion. Perform algebraic product, bounded sum and bounded difference over the two fuzzy sets.

10 State the conditions for fuzzy tolerance and fuzzy equivalence relations? (3)

11 The fuzzy relations are given as (3)

$$R = \begin{matrix} & \begin{matrix} y_1 & y_2 & y_3 \end{matrix} \\ \begin{matrix} x_1 \\ x_2 \end{matrix} & \begin{bmatrix} 0.1 & 0.2 & 0.3 \\ 0.4 & 0.5 & 0.6 \end{bmatrix} \end{matrix} \quad S = \begin{matrix} & \begin{matrix} z_1 & z_2 \end{matrix} \\ \begin{matrix} y_1 \\ y_2 \\ y_3 \end{matrix} & \begin{bmatrix} 0.8 & 0.1 \\ 0.6 & 0.9 \\ 0.4 & 1.0 \end{bmatrix} \end{matrix}$$

Perform composition over the two given fuzzy relations and obtain a fuzzy relation  $T$ .

#### PART D

*Answer any two full questions, each carries 9 marks.*

12 a) An athletic race was conducted. The following membership functions are defined based on the speed of athletes: (6)

$$\mu_{\tilde{Low}} = \left\{ \frac{0}{100} + \frac{0.1}{200} + \frac{0.3}{300} \right\}$$

$$\mu_{\tilde{Medium}} = \left\{ \frac{0.5}{100} + \frac{0.57}{200} + \frac{0.6}{300} \right\}$$

$$\mu_{\tilde{High}} = \left\{ \frac{0.8}{100} + \frac{0.9}{200} + \frac{1.0}{300} \right\}$$

Find the following:

(a)  $R = \tilde{Low} \times \tilde{Medium}$

(b)  $S = \tilde{Medium} \times \tilde{High}$

(c)  $T = R \circ S$  using max-min composition

b) Explain any two defuzzification methods? (3)

13 a) Explain the features of membership functions? (3)

b) Differentiate between Normal and subnormal fuzzy set. (2)

c) Using intuition and your own definition of the universe of discourse, plot fuzzy membership functions to the following variables: (4)

(i) Liquid level in the tank

(a) Very small

- (b) Small
  - (c) Empty
  - (d) Full
  - (e) Very full
- 14 a) What is meant by Lambda cut of a fuzzy set? Show that Lambda cut relation of fuzzy relation is crisp. (4)
- b) Using inference approach, find the membership values for each of the triangular shapes ( $L$ ,  $R$ ,  $E$ ,  $IR$ ,  $T$ ) for each of the following (all in degrees): (5)
- (a)  $20^\circ$  ,  $40^\circ$  ,  $120^\circ$

### PART E

*Answer any four full questions, each carries 10 marks.*

- 15 a) Define Tautology. Prove the tautology  $(P \Rightarrow Q) \vee (Q \Rightarrow P)$  using Truth values in Fuzzy Logic? (5)
- b) What are Fuzzy propositions? List the operations on Fuzzy propositions? (5)
- 16 a) Give the Canonical form of Fuzzy Rule Based System. Give the syntax for the formation of Fuzzy rule using (5)
- i) Assignment statements
  - ii) Conditional statements
  - iii) Unconditional statements
- b) Explain any two methods for the decomposition of fuzzy rules. (5)
- 17 What is Fuzzy Inference System (FIS)? Illustrate Mamdani FIS and Sugeno FIS with examples? (10)
- 18 What are Genetic Algorithms (GA)? Explain the operators in GA? (10)
- 19 a) Explain *four* mutation methods? (8)
- b) List the stopping condition for Genetic Algorithm Flow? (2)
- 20 a) State the properties of Genetic Neuro Hybrid System. Draw the block diagram of Genetic Neuro Hybrid System. (5)
- b) What is Cooperative Neural Fuzzy system? Illustrate its classification types? (5)

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